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EXPERIMENTS WITH FUNGICIDES UPON POTATOES IN 1900.

HOW TO FIGHT POTATO ENEMIES.

This Bulletin contains the results of spraying experiments for potato blight and potato rot with freshly prepared and commercial "ready for use" Bordeaux mixture, and gives explicit directions for combatting the more common insect and fungus enemies of the potato.

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EXPERIMENTS WITH FUNGICIDES ON POTATOES

IN 1900.

CHAS. D. WOODS.

As noted in Bulletin 68 of the Station, a spraying experiment with Bordeaux mixture as a preventative of potato blight was successfully carried out on a farm of Mr. John Watson in Houlton. Mr. Watson placed the whole of the potato fields on his farm, and the services of his farm laborers at the disposal of the Station. The experiment was planned partly as a demonstration of the value of Bordeaux mixture when applied on a large scale, and partly as a comparison between freshly prepared Bordeaux mixture and the ready prepared goods on the market.

THE FUNGICIDES USED.

The Bordeaux mixture was prepared according to the following formula.

Copper sulphate	5 pounds
Fresh lime (unslaked)	5 pounds.
Water	50 gallons

A single barrel can be readily prepared as follows:

The copper salt is dissolved in a wooden tub or earthen jar and the lime slaked in a separate vessel. Dissolve the copper sulphate in about two gallons of hot water in a wooden or earthen vessel by stirring, or by suspending it from the top of the vessel in a cloth bag, immersed in the water; pour the solution into the tank or barrel used for spraying and fill one-third to one-half full of water. Slake the lime in a separate vessel by the addition of a small quantity of water, and when slaked add two or three gallons of water and stir freely. Pour the milk of lime thus made into the copper sulphate solution, passing it through a brass wire strainer of about 30 meshes to the inch (No. 50), or through a cheese-cloth backed by common window screen. Stir constantly while adding the lime. Add water to make the amount up to 50 gallons.

In this work, where so much Bordeaux was needed, much time was saved by first preparing stock solutions. The stock solutions used in this experiment were prepared in accordance with the directions given on page 63.

Bowker's Boxal, made by the Bowker Chemical Company, of Boston, is a "manufactured form of Bordeaux mixture," to which an insecticide (disparene or arsenate of lead) has been added. Boxal differs from the usual Bordeaux mixture in that precipitated copper hydrate has been added to it and it contains relatively more copper and less gypsum than ordinary Bordeaux mixture. This added copper hydrate did not soften upon the addition of water as readily or so completely as the other part of the Boxal. The directions on the package called for 5 pounds of Boxal to each 50 gallons of water. Just before the first spraying, a printed postal card was received from the firm saying, "Owing to the remarkable abundance of the potato beetle we are of the opinion that you will obtain the best results by using 10 pounds of Boxal to 50 gallons of water." Accordingly two plots were sprayed with Boxal, one at the rate of 5 pounds and the other at the rate of 10 pounds per acre. If Boxal contains no more copper than Bowker's Bodo,* it will take about 18 pounds to 50 gallons to make a mixture of the same strength as the freshly prepared Bordeaux mixture used in these experiments.

Adler's Bordeaux mixture. This was a prepared mixture so made that each gallon contained $2\frac{1}{2}$ pounds copper sulphate and $2\frac{1}{2}$ pounds of lime. It was used by diluting 1 gallon with 24 gallons of water and thus had the same strength as the freshly prepared Bordeaux mixture.

Lion Brand Bordeaux mixture is prepared by James A. Blanchard, of New York City. It is "ready for immediate use by adding 49 gallons of water to 1 gallon of the mixture." It is put up in gallon cans which retail for one dollar each.

METHOD OF APPLYING.

The fungicides were applied in a fine mist or spray by means of a four-rowed mechanical sprayer, fitted with a powerful hand pump. In the first application the machine was fitted with single

* A manufactured form of Bordeaux mixture, which was not received soon enough to be used in this experiment, but which was successfully used by a few potato growers in Aroostook county in 1900.

Vermorel nozzles and the plots were gone over twice in opposite directions. In the three other sprayings, double Vermorel nozzles were used. Insecticides were used in each application, although in the first and fourth sprayings they were not needed. With the pump used, Bordeaux mixture will be forced through double Vermorel nozzles at the rate of about one barrel to the acre. In practical work on a large scale a spraying outfit with power pump can be advantageously used. In these experiments a hand pump was chosen, as the pressure was then under complete control. As it was desired to take every precaution for thorough spraying, two men were on the cart, one to pump, the other to drive and watch that the nozzles did not get stopped.

ARRANGEMENT OF PLOTS.

The field selected for the test of the commercial Bordeaux mixtures was the same as that used for insecticides (See Bulletin 68). This field was planted with Green Mountain potatoes late in April, the rows running east and west. There were 224 rows about 30 rods long running across the field, and in addition about 20 shorter rows at the north and ten at the south ends of the field. The arrangement of the plots and their treatment is shown in the following plan:

Each plot for the prepared Bordeaux mixture consisted of 18 rows about 30 rods long. The rows ran east and west. Row 1, at north end. Unsprayed rows were left at each end of field.

1 to 16	Bordeaux mixture, 1 barrel to acre
17 to 32	Bowker's Boxal, 5 pounds to acre
33 to 48	Bowker's Boxal, 10 pounds to acre
49 to 64	Adler's Bordeaux, 1 gallon to acre
65 to 80	Bordeaux mixture, 1 barrel to acre
81 to 96	Blanchard's Bordeaux, Lion brand, 1 gal. to acre
97 to 224	Bordeaux mixture

Dates of applications:

July 11. Bloom just beginning.

July 21.

July 27. In full bloom.

Aug. 10. Still in bloom.

The fungicides were applied under the personal supervision of the writer, and the fields were visited and full notes taken at frequent intervals.

NOTES TAKEN IN THE FIELD.

July 11. Potatoes just beginning to bloom. No blight of any kind to be seen. All sprayed plots treated today for first time and each row sprayed twice, once from the east and once from the west, with single Vermorel nozzle. It began to rain after the plots were sprayed.

July 21. All plots sprayed once with double Vermorel nozzle. Untreated rows sprayed with lime and Paris green. It began to rain after plants were sprayed.

July 24. Potatoes in full bloom. Rows 1 to 16. Plants very well covered with Bordeaux mixture. Rows 16 to 32 very little indication of Boxal on foliage. Rows 33 to 48 Boxal readily seen on foliage. Well distributed. Rows 49 to 64. Plants well covered with Bordeaux mixture, although it does not show up as plainly as on rows 1 to 16. Rows 65 to 80. Leaves fairly well covered with Bordeaux mixture. Rows 81 to 96. Bordeaux shows up about the same as Boxal on rows 33 to 48. Rows 97 and beyond well covered with Bordeaux mixture.

July 25. Heavy Rain.

July 27. All plants sprayed. The mixtures were applied from the direction opposite to that of July 21.

Aug. 1. Heavy shower last night. Field still white with bloom. The tops are nearly touching between the rows all over the field. On the very steep slopes, and particularly at the foot, plants did not get as well sprayed. Rows 1 to 16. Bordeaux mixture on all the leaves except the very newest. Rows 17 to 32. Boxal shows a little on the leaves. Rows 33 to 48. Boxal shows much plainer than on rows 17 to 32. Rows 49 to 64. Bordeaux mixture about as conspicuous as the Boxal on rows 33 to 48. Rows 65 to 80. Bordeaux mixture conspicuous on all except last new leaves. Rows 81 to 96. Bordeaux does not show as evenly over the leaves as the regular Bordeaux does. Rows 97 and beyond. Bordeaux mixture well distributed.

Aug. 3. Heavy rain.

Aug. 8. Plants have grown 8 to 15 inches since last spraying (July 27). Blossoms are beginning to fall. No signs of blight unless it be five or six blackened leaves on rows 193 to 208. The spraying still covers the old leaves.

Aug. 10. Sprayed rows 1 to 112. It thickened up and began to sprinkle while rows 97 to 112 were being sprayed. The

shower was very light but it did not clear up again during the day. Blight was reported as having been found in several fields in Houlton and vicinity. No signs of blight in this field unless it be on a few leaves on north unsprayed end rows.

Aug. 11. Rows 113 to 224 sprayed.

Aug. 14. Plants still in bloom so that the blossoms are conspicuous at a distance. Came up unexpectedly because of telegram saying that blight had appeared in the field. The blight was apparent in a few places on the low parts of the whole field. The plants were all carefully examined and the following notes taken: Rows 1 to 16. For two rods at east where ground is low and soil heavy, it has been very wet and plants are small and poor. There is some blight here on lowest leaves. In a hollow near east end where the plants are rank, soft and "leggy," there is a little blight on a few of the lowest leaves. Otherwise practically no blight on plot. Rows 17 to 32. Very well sprayed. A few leaves are brown, or have brown tips. If there was no blight elsewhere should not suspect these. Rows 35 to 48. Well sprayed. There are a few blackened leaves, apparently bruised at last spraying. Very little, if any, suspicions of blight. Rows 49 to 64. Well sprayed. No indications of blight. Rows 65 to 80. Well sprayed. No indications of blight. Rows 81 to 96. A few plants at extreme east with brown particles on leaves but it does not look like blight. Last spraying not conspicuous on the wet (with dew) leaves, but careful examination shows that it is there. If there was no blight elsewhere, I should say there was no reason to think there was any on this plot. Rows 97 to 112. Well sprayed. An occasional brown spot which may be blight, but should not think so if it were not for blight elsewhere. Rows 113 to 128. Pretty well sprayed. A few black patches which look like blight on some of the lowest leaves. This is especially the case at the east end where plants are rankest. Rows 127 to 144. For three or four rods at west end many of the lowest leaves are dead with blight. Some indications of blight all along. Less in the middle and east except that for 1 rod at east end there are quite a number of dead leaves. Rows 145 to 160. Very little indication of blight except in west end where a few leaves are dead or nearly so. Not nearly as bad as west end of rows 129 to 144. Rows 161 to 176. Pretty well sprayed. Very little if any indications of blight; should not be

suspicious if blight were not on other plots. Rows 177 to 192. Pretty well sprayed. Only an occasional leaf with blight spot except on west end, where for four rods quite a good many of the lowest leaves are dead. Rows 193 to 208. Spraying not very good. At west end many of lowest leaves dead with blight. The blight grows less and less for 6 to 8 rods, beyond which there are very little indications of blight except in a hollow where water stands after a rain, and on a knoll near the east end (the potatoes on this knoll when dug were scabby). Rows 209 to 224. Fairly well sprayed. Very little indications of blight on east half. West half about the same as 193 to 208. Unsprayed rows at north end of field. Tops at east end very large and spreading. At west smaller with blossoms mostly fallen. Blight on east part abundant on lower leaves. A good many lower leaves dead and many others with spots of blight a half inch or more across. Very little rust on middle and west end. Unsprayed rows at south end of field. Blight abundant in marked contrast to rows 209 to 224 adjoining.

Aug. 23. Walked through each plot and made notes. The blossoms are practically off from the whole piece. Some of the plants are beginning to turn yellow,—apparently ripening. The effect of spraying with copper salts is very evident on all the plots. Some plots are still entirely free from blight. Rows 1 to 16. Blight has made very little progress; there is practically none except on the east end for 4 rods or so and no badly affected plants. Rows 17 to 32. A little blight on the whole plot. The plants at east end and in hollow have considerable, others very little blight. Many plants entirely free from blight. Rows 33 to 48. Practically no blight on west half. The east slope (quite steep) has some blight for 2 rods. Otherwise no blight except on an occasional leaf. Rows 49 to 64. Practically no blight. A few leaves on east side of slope (steep, but not so steep as on rows 35 to 48) show signs of blight. Rows 65 to 80. Practically no signs of blight. A few leaves are brown and curled on edges. No spots as in blight. Rows 81 to 96. A few blight spots in leaves on most of the plants. There are practically no dead leaves, however. Rows 97 and beyond. The blight has made practically no progress on these plots since Aug. 24. The leaves which were badly affected then are dead. Very little new blight apparent.

Sept. 4. Field as a whole doing finely and ripening. Rows 1 to 16. Blight making no progress. Rows 17 to 32, 33 to 48, 49 to 64. Blight making some progress, but probably not enough to seriously interfere with growth and ripening. Rows 65 to 80. Practically no blight. An occasional leaf on an occasional plant shows a small spot. Rows 81 to 96. Blight has made little advance since Aug. 23. Some dead leaves. Rows 97 to 224. Blight has made little, if any progress, since August 14. Unsprayed rows at north end of field. Some plants only a little affected with blight. Most of the plants are three-fourths dead with blight. Unsprayed rows at south of field. Except on the north side of the row next to 224 there is not a green leaf. The stalks are for the most part still standing and are green.

Sept. 7. Plants badly checked and nearly killed by severe frost. The top leaves are all blackened.

Sept. 29. Because of inequalities in the field it was not practicable to select even twentieth acre pieces in each plot that would be fairly comparable in yield with the different fungicides. At harvest there was very little rot found on any of the sprayed plots. There were rather more rotten potatoes on the Boxal and Blanchard's Bordeaux plots than on the others. But even these had so few rotten potatoes that they could be fairly said to have "practically no rot." The Adler's Bordeaux which differed from the regular Bordeaux only in not being freshly prepared, gave only 5 decayed potatoes in a row 30 rods long which was as well as in the case of the freshly prepared Bordeaux mixture.

YIELD FROM UNSPRAYED AND SPRAYED ROWS COMPARED.

The vines at the south end of the field were not as rank nor the yield as great as at the north end of the field. On rows 1 to 16 and 209 to 224 and on the unsprayed rows which joined these plots, twentieth acre strips (apparently similar except that one had been sprayed and the other was not) were measured and the crop harvested, Sept. 29. The yield was as follows:

YIELD OF POTATOES FROM ADJOINING SPRAYED AND UNSPRAYED 1-20 ACRE PLOTS.

	YIELD OF POTATOES.					
	Pounds per 1-20 Acre.			Bushels per Acre.		
	Merchantable.	Small.	Rotten.	Merchantable.	Small.	Rotten.
North part unsprayed.	553	96	101	184	32	34
Adjoining rows sprayed.....	957	95		319	32	
South part unsprayed.	330	94	81	110	31	27
Adjoining rows sprayed... ..	738	90		246	30	

READY MADE VS. FRESHLY PREPARED BORDEAUX MIXTURE.

Effectiveness. The Boxal and Lion brand Bordeaux mixture, in the amounts used in these experiments, contained less copper than the regular Bordeaux mixture. The Adler's Bordeaux mixture, however, was applied so that it was of the same strength as the freshly prepared Bordeaux mixture here used. Both as indicated by freedom of vines from blight and tubers from rot, the ready made Bordeaux (Adler's) apparently was as effective as the freshly made. The Boxal and Lion brand Bordeaux mixture was not quite as effective in preventing blight and subsequent rot of the tubers as the freshly prepared mixture. This may be explained by the fact that as used, these goods did not carry as much copper as the regular Bordeaux mixture.

In these experiments Bordeaux mixture which had been made for weeks was as effective in preventing blight and subsequent rot as the freshly prepared. Boxal and Blanchard's Lion brand Bordeaux mixture protected the plants and the tubers from destruction by blight and rot. While in these experiments they were not as effective as the regular Bordeaux mixtures, they can under most conditions be depended upon to protect the potato plant. They would probably be more effective if used in stronger mixtures.

"The Ready for Use" Feature. The claim is justly made by the manufacturers that the prepared Bordeaux mixtures are

ready for use, since they only need to be diluted with the requisite amount of water. If one is using much Bordeaux mixture this is of little practical importance, for by using stock solutions freshly prepared Bordeaux mixture (with allowance for time of preparing stock solution) can be as quickly prepared as the ready made goods can be stirred up and diluted.

The Cost. Copper sulphate costs at retail, in lots of 50 to 200 pounds, about 7 cents per pound. Lime costs about 50 cents a hundred by the cask. Thus the materials for making a barrel (50 gallons) of Bordeaux mixture costs between 40 and 50 cents. The prepared goods of *this strength* are practically as good as the freshly prepared. The small grower will probably find the ready made goods enough more convenient to justify a somewhat higher cost. The large grower should not with present prices pay much more than at the rate of 50 cents for enough material to make a barrel of the mixture. The trouble of preparing the mixture from lime and sulphate of copper is slight. Enough lime to make ten barrels of the mixture was weighed out, slacked and strained by the writer in 23 minutes. Making the copper sulphate solution takes practically no labor, although it will be several hours after it is suspended in the water before it will be all dissolved.

DOES SPRAYING WITH COPPER SALTS PAY?

In the experiments here reported upon, four sprayings with Bordeaux mixture at a cost, including labor of man and team, of not more than at the rate of \$2.50 per acre gave 280 bushels of first-class potatoes as against a yield of 147 bushels of green and too small potatoes to command a ready sale. At the prices which prevailed at time of digging, the crop from the sprayed would have sold for \$106.40; \$102 for the merchantable and \$4.40 for the starch potatoes. The crop on the unsprayed would have sold only with difficulty except for starch, but assuming that the so-called merchantable could have been sold for the same price as the sprayed, the money value of the crop would be \$62.60; \$53.50 for the good potatoes and \$9.10 for the starch potatoes. The investment of \$2.50 gave at the least a money return of more than \$40.00 per acre.

To be effective, spraying must be rightly done and at the proper time. Full directions for spraying the potato are given in the article which follows.

HOW TO FIGHT POTATO ENEMIES.

CHAS. D. WOODS.

Because of the importance of the subject and numerous inquiries from correspondents, the following specific directions for combatting the more common insect and fungus enemies of the potato have been prepared. The directions are based not only upon our experiments, experience and observation, but upon those of other investigators and practical growers in this and other states.

By far the larger part of the enemies of the potato may readily be held in check by spraying with the more common insecticides and fungicides, and often, by a combination of materials, several enemies may be met with one application. The insect enemies can be met *after* they appear. The fungus diseases can be prevented and the successful fight must be made *before* they appear. In some seasons there is comparatively little loss from the attack of fungus diseases. In others the crop is a failure unless preventive measures are taken. No man can tell before hand whether the season will be favorable to the growth of the fungi or not. The moral is evident. Preventive measures must be taken with each crop.

INSECT ENEMIES.

The flea beetle, which eats small round holes in the leaves, and the Colorado beetle ("potato bug"), which prefers the leaves, eats the stems and will eat the tuber if nothing else offers, readily succumb to poison. Their very greediness makes them the easier victims.

No adequate substitute for arsenical poisons has yet been found. Some things are distasteful and if abundantly applied will drive the beetles. Paris green is the most generally used. Lead Arsenate proved the most satisfactory with us.* To kill all the bugs the poison must be distributed over the entire plant. This is most readily and surely done by spraying. See formulas 3, 3a, 4 and 4a.

*For results of experiments with insecticides on potatoes see Bulletin 68 of this Station.

FUNGUS DISEASES.*

While there are several fungus diseases which attack the potato, the scab and the early and late blight are the most prevalent and the ones most to be feared in Maine.

POTATO SCAB.

Potato scab, which is too well known to need description, can be held in check by planting previously treated seed in clean land. As it is next to impossible to get this fungus out of the soil, great care should be taken not to get it in. Soak the uncut seed potatoes for two hours in either formula 1 or 1a and then spread out to dry. After drying the potatoes may be cut and planted in the usual way, care being taken not to allow them to touch any box, bag or bin where scabby potatoes have been kept. All treated tubers should be planted to avoid danger from the poison on them.

EARLY BLIGHT.

This disease is wide spread and destructive. It is confined to the leaves and green stems, and appears about the time the tubers begin to form, but may come earlier if the growth of the plants has been checked in any way. The first indication of its presence is the appearance on the leaves of grayish brown spots, which soon become hard and brittle. The disease progresses rather slowly, the spots gradually becoming larger, especially along the edges of the leaflets. At the end of ten days to two weeks half of the leaf surface may be brown, withered, and brittle, while the rest is of yellowish green color. The tubers stop growing almost as soon as the leaves are attacked, and as a result the crop is practically worthless. This can be prevented by the use of Bordeaux mixture, formula 2.

LATE BLIGHT, OR ROT.

This disease attacks the leaves, stems and tubers. Generally the first noticeable effect upon the leaves is the sudden appearance of brownish or blackish areas, which soon become soft and foul smelling. So sudden is the appearance of the disease in some cases, that fields which one day look green and healthy may within the next day or two become blackened as though swept

*For illustrated description of the fungus diseases of the potato send to your congressman, or the Secretary of Agriculture, Washington, D. C., or to this Station for Farmers' Bulletin No. 91 of the U. S. Department of Agriculture.

by fire. The rapid spread of the disease, which is caused by a parasitic fungus, is dependent in large measure upon certain conditions of moisture and heat. A daily mean temperature of from 72° to 74° F. for any considerable time, accompanied by moist weather, furnishes the best conditions for the spread of the parasite. On the other hand, if the daily temperature exceeds 77° for a few days, the development of the disease is checked. This fact explains why the fungus seldom occurs to any serious extent in sections where the mean daily temperature exceeds 77° for any length of time, and probably why it appears later than the so-called early blight. The late blight not only stops the growth of the tubers but causes them to rot. Bordeaux mixture (formula 2) will prevent this.

LEAF DISEASES, ETC., RESEMBLING BLIGHT.

Leaf burn or scald sometimes occurs and may be confused with early blight. The tips and edges of the leaves turn brown and these discolored areas soon become hard and brittle. The burning or scalding may occur at any time and is the result of unfavorable conditions surrounding the plant. Long continued cloudy and damp weather followed by several hot and bright days is apt to result in the burning of the foliage. Leaf burn may also occur as the result of protracted dry weather.

Leaf poisoning or burning may occur where Paris green is applied to potatoes and frequently it can not be distinguished from early blight by any ordinary examination. It sometimes happens, therefore, that farmers are led to believe that their potatoes are affected with early blight and other diseases when the trouble has been brought on by themselves through the improper use of Paris green. Injuries resulting from the use of this substance are very apt to occur where flea beetles have eaten the foliage. The arsenic attacks the tissues at such points, and as a result more or less circular brown spots are produced, having for their centers the holes eaten out by the flea beetles. By combining the Paris green with Bordeaux mixture or with lime, these injuries may be avoided.

HOW TO SPRAY.

Spraying is an effective method of applying insecticides and fungicides. To obtain the best results, the material must be applied forcibly in the form of a fine mist, *not* in coarse drops sprinkled over the foliage. Inasmuch as spraying is a preventive measure (not a cure) the whole surface of the plant must, so far as possible, be covered.

THE APPARATUS.

The necessary apparatus consists of a force pump, hose, nozzles, a barrel for holding the spraying mixture and a wagon for carrying all.

The Pump: The pump should be large enough to easily supply 4 double nozzles and should have as an accessory a good agitator. The small bucket pumps and knapsack sprayers do very well for a few plants in the kitchen garden, but for field work they are unsatisfactory. All parts of the pump that are subject to wear should be made of brass and should be carefully adjusted. The pump and all other apparatus should be thoroughly washed every time after using.

The Hose: In case an automatic sprayer is not used, 2 pieces of 1-2 inch hose 10 to 20 feet long are needed.

The Nozzle: There are many good nozzles, but the best tried at the Experiment Station, are the Vermorel, sold by most dealers in spraying apparatus; the McGowen, made by John J. McGowen, Ithaca, N. Y., and the Bordeaux, made by the Deming Company, Salem, Ohio. The Vermorel throws a finer spray than the others, and is the best for potatoes, but is easily clogged unless the spraying mixture is carefully strained through cheesecloth or a fine wire screen before using. With automatic sprayers, double nozzles should be used.

The Barrel: A kerosene barrel, holding about fifty gallons, is a convenient tank. It can be placed upon the side or stood on end, but the first position is preferable. A small opening should be made in which to place the pump, and another, larger one, through which to fill the tank and stir the mixture.

The Wagon: Any low wagon, or even dump-cart will answer the purpose. For convenience in turning, a two wheeled cart is to be preferred.

Automatic Sprayers: In large fields automatic sprayers which will cover four rows at once may be used with satisfactory results. Such a machine consists essentially of a barrel, containing an agitator for keeping the liquid stirred, mounted upon a two wheeled cart, a force pump (which may be a hand pump, but preferably one driven by a spocket chain in the rear) with nozzles which can be set to any width of row. To give the best results two nozzls should be used for each row. Combinations of two nozzles can be obtained from dealers.

FORMULAS.

CAUTION: *The following formulas are for use on the potato. In many cases they are not adapted for more tender plants. Keep all poisons carefully labelled and out of the reach of children and animals.*

Formula 1. CORROSIVE SUBLIMATE.

Corrosive Sublimate 2 ounces
Water 15 gallons

The corrosive sublimate dissolves readily in water.

Formula 1a.

Formaline (40% solution formaldehyde) 8 fluid ounces
Water 15 gallons

Formula 2. BORDEAUX MIXTURE.

Copper Sulphate 5 pounds
Fresh Lime (unslacked) 5 pounds
Water 50 gallons*

The copper salt is dissolved and the lime slacked in separate vessels. Dissolve the copper sulphate ("Blue Stone") in about two gallons of hot water in a wooden or earthen vessel by stirring, or by suspending it from the top of the vessel in a cloth bag; pour the solution into the tank or barrel used for spraying and fill one-third to one-half full of water. Slack the lime by the addition of a small quantity of water, and when slacked add two or three gallons of water and stir freely. Pour the milk of lime thus made into the sulphate solution, passing it through a brass wire strainer of about 30 meshes to the inch (No. 50) or through a cheese-cloth backed by common window screen.

* An ordinary oil barrel holds about 50 gallons.

Stir constantly while adding the lime. Add water to make the amount desired.

Much time may be saved by preparing stock solutions. While any proportions can be used, the following was found in the spraying experiments made by the Station a convenient way:

The stock solution of copper sulphate is made by weighing out 50 pounds of copper sulphate, placing it in a bag and suspending it in the top of a barrel containing 30 gallons of water. The copper sulphate dissolves completely in a few hours. The stock solution of the lime is prepared by slacking 50 pounds of lime, and adding water so as to make up to 30 gallons and straining through No. 50 brass screen cloth. To slack and strain this amount of lime takes less than one-half hour. For use, 3 gallons of each solution and 44 gallons of water make up the formula give above. The stock solution of lime should be kept well covered and be thoroughly stirred before dipping out.

Formula 3. BORDEAUX MIXTURE AND PARIS GREEN.

Paris Green	1/2 pound
Bordeaux Mixture	50 gallons

Make a paste with the Paris green and a little water. Add to the Bordeaux mixture and stir thoroughly.

Formula 3a. BORDEAUX MIXTURE AND LEAD ARSENATE.

Lead Arsenate or Disparene.....	1 pound
Water	50 gallons

Formula 4. PARIS GREEN.

Paris Green	1/2 pound
Lime (unslacked)	3 pounds
Water	50 gallons

The standard remedy for the destruction of insects which eat the foliage or fruit. The lime is added to prevent the Paris green from burning the foliage. Slack the lime in a little water, make into a thin paste and strain. Wet up the Paris green with a little water into a thin paste. Mix the lime and Paris green and add the remainder of the water. A stock solution of lime can be made as described under formula 2.

Formula 4a. LEAD ARSENATE.*

Lead Arsenate 1 pound
 Water 50 gallons

Arsenate of Lead acts slower as a poison than Paris green. It can be kept suspended in the water better than Paris green; it does not burn foliage and sticks to the foliage better than Paris green. For these reasons it proved, in our experiments in 1900, more satisfactory than Paris green.

WHAT TO DO, AND WHEN AND HOW TO DO IT.

The treatment at various times during the season and the purpose of the same, briefly stated, are as follows:

A. Corrosive Sublimate (formula 1) or Formaline (formula 1a): before planting immerse the tubers for two hours, then dry and cut. For scab.

B. Bordeaux mixture and Paris green (formula 3) or Bordeaux mixture and lead arsenate (formula 3a): when the plants are three or four inches high, or as soon as the potato beetle appears. For potato beetle, flea beetle, and early blight.

C. Repeat B at intervals so as to keep new leaves protected.

D. Bordeaux mixture (formula 2) about August 1 to 15. For late blight and rot.

E. Repeat D after about two weeks.

Four sprayings are usually sufficient to protect from blight.

Begin while the tops are still small and spray again as soon as tops have made 6 or 8 inches of new growth and keep this up as long as the tops are growing rapidly.

Directions for spraying the apple and how to fight cucumber enemies will be sent on application.

CHAS. D. WOODS, *Director*,
 Orono, Maine.

*Swift's Lead Arsenate or Bowker's Disparene.

